

Recreation



- IPUOCR is kayaking and canoeing
- Flow dependent at average to high flows
- Not navigable at low flow
- Evaluated qualitatively
- Will be evaluated more quantitatively if water management results in changes in average or high flows

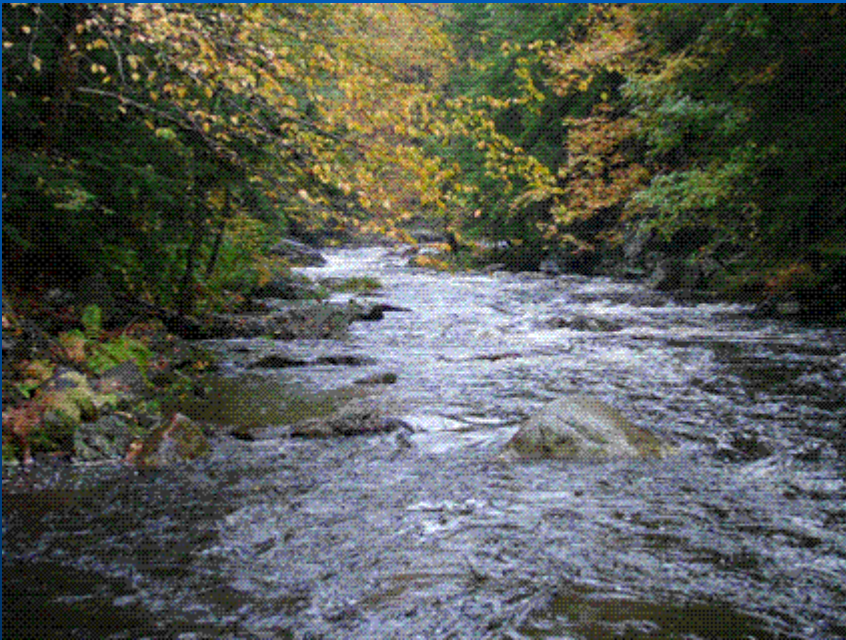
Survey of Boaters

- How often do you boat on the Souhegan?
- Where did you travel from?
- How do you monitor flow conditions on the Souhegan?
- Which reaches of the river do you run?
- What is the best flow range to run?
- What is the minimum flow you would consider running?

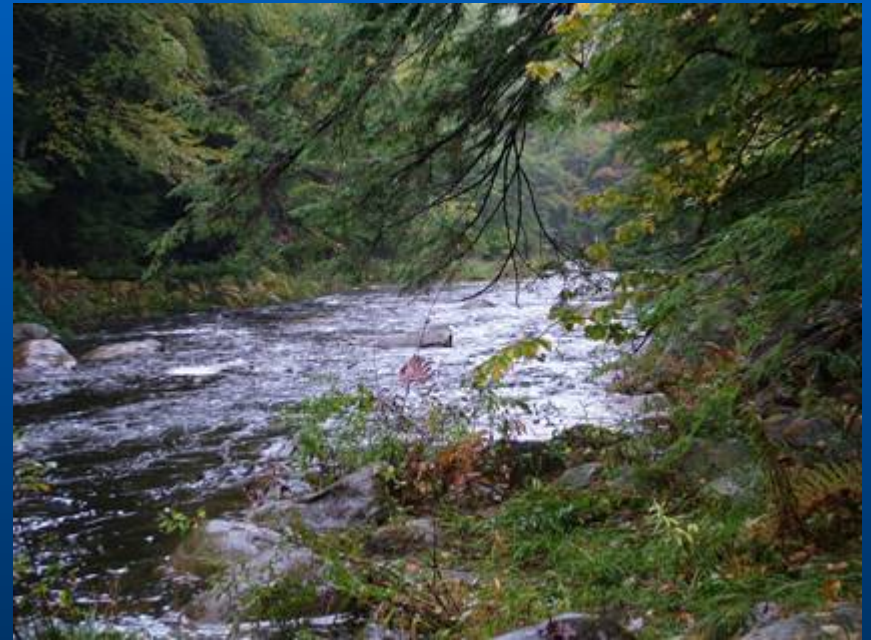
October 10 survey

- Flows at Merrimack gage declining from 815 cfs to 761 cfs
- 9 boaters interviewed
- Primary interview site was Route 31 crossing near Greenville line
- Some boaters were putting in, some were taking out.

Greenville Access



**Upstream of Greenville
Access**



**Downstream of Greenville
Access**

Boaters gage in Greenville



View near Rte 31



Upstream of Rte 31



Rte 31 Bridge

Access points of Route 31 Bridge



Rapid below launch



Population surveyed

- Most boated Souhegan 3-4 times/yr
 - One had not been on river in 25 yrs
 - One boated river 12 times yr
- Many had yrs of experience on Souhegan
- All from southern NH and northern MA (furthest Lexington, Ma)
- 8 kayakers and 1 canoeist

Flow Assessment

- Boating season includes spring snowmelt and other major runoff events including hurricane remnants and slow moving fronts.
- Greenville section the most popular
- Rare to run river in summer
- 700 cfs at Merrimack generally agreed as the minimum flow for running
- Approx 1200 cfs is optimal flow
- Higher flows are in trees and considered dangerous but still run by some

Estimated chance (%) of finding the river runnable.

Month.....% chance.....comment

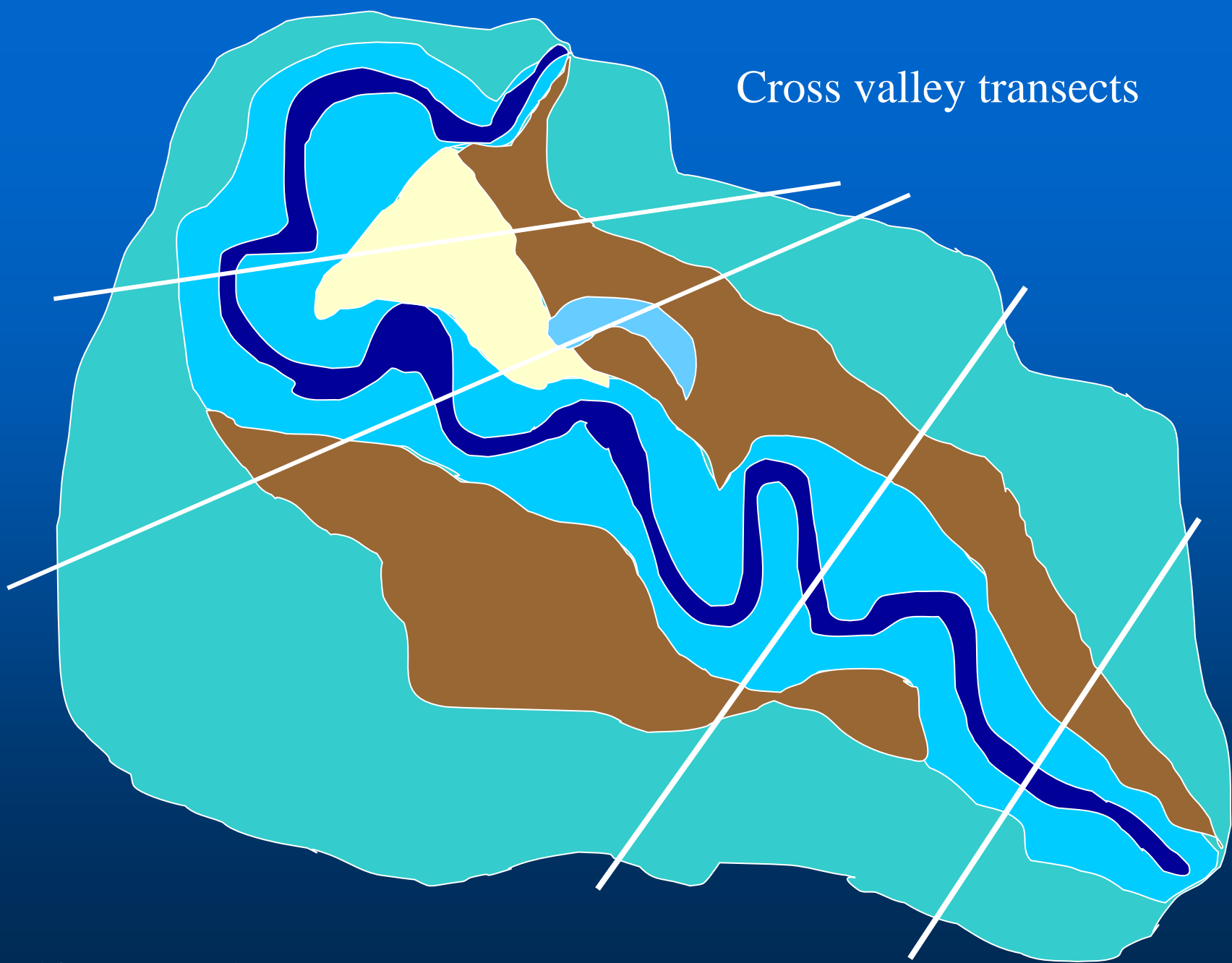
January	5%....	Usually frozen
February.....	10%....	Usually frozen
March.....	40%....	Opens up about mid month
April.....	65%....	Best chance in early April
May	20%....	Best chance in early May
June.....	8%	
July.....	5%	
August.....	5%....	Just a trickle
September.....	10%....	remains of Tropical storms
October.....	15%	
November.....	20%....	Fall rains, dormant trees
December.....	20%....	Freeze near Christmas

Other flow considerations

- Gage at Merrimack used but considered poorly correlated with upper river conditions when flows are changing rapidly
- Stoney Brook gage (decommissioned) was much more representative of upper Souhegan
- Hand painted gage used once boaters at river
- Better gaging would be welcomed by the boating community

Natural Communities

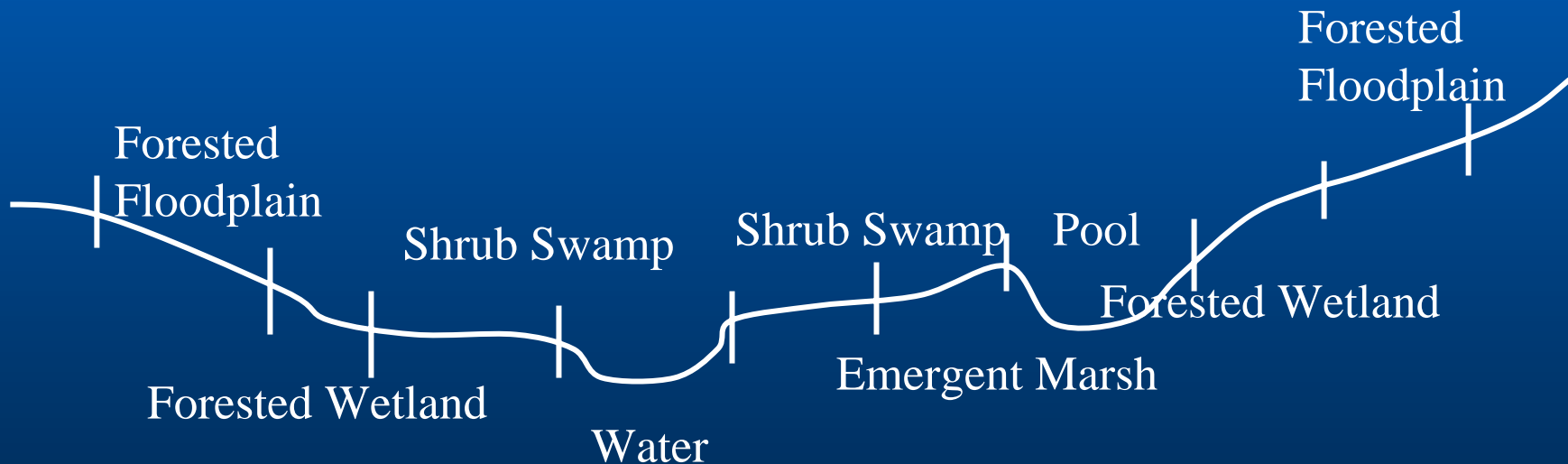
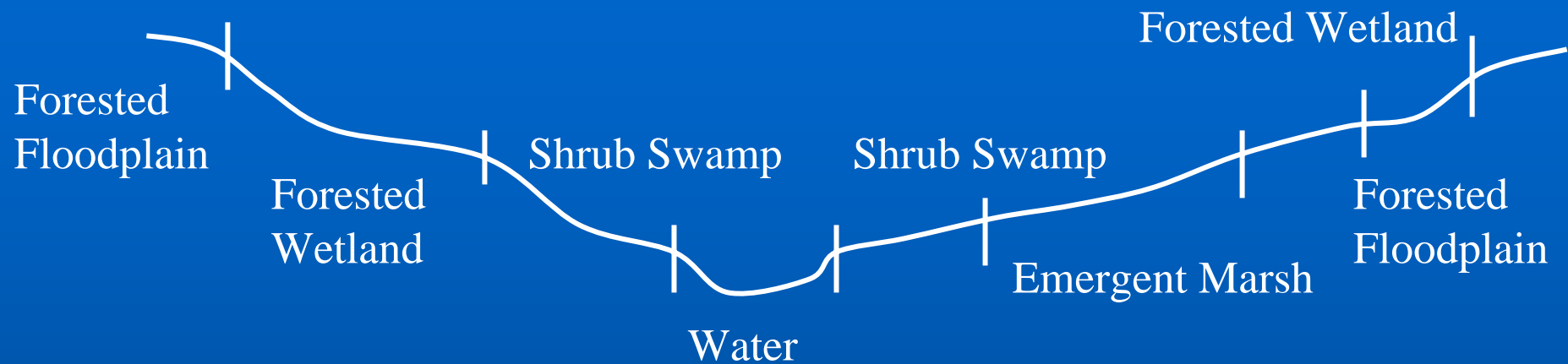




Cross valley transects

Adapted from Scott Jackson, UMASS

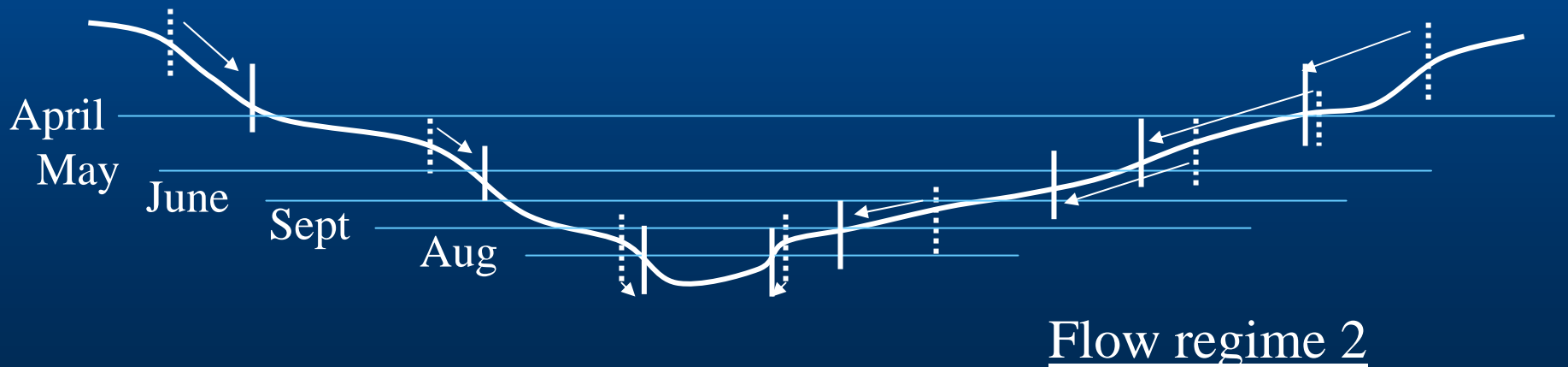
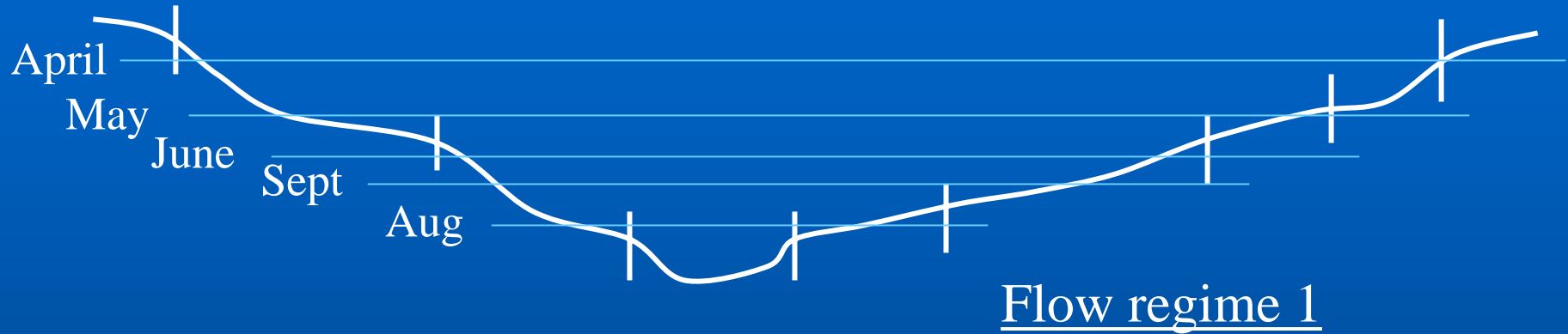
Transect #1



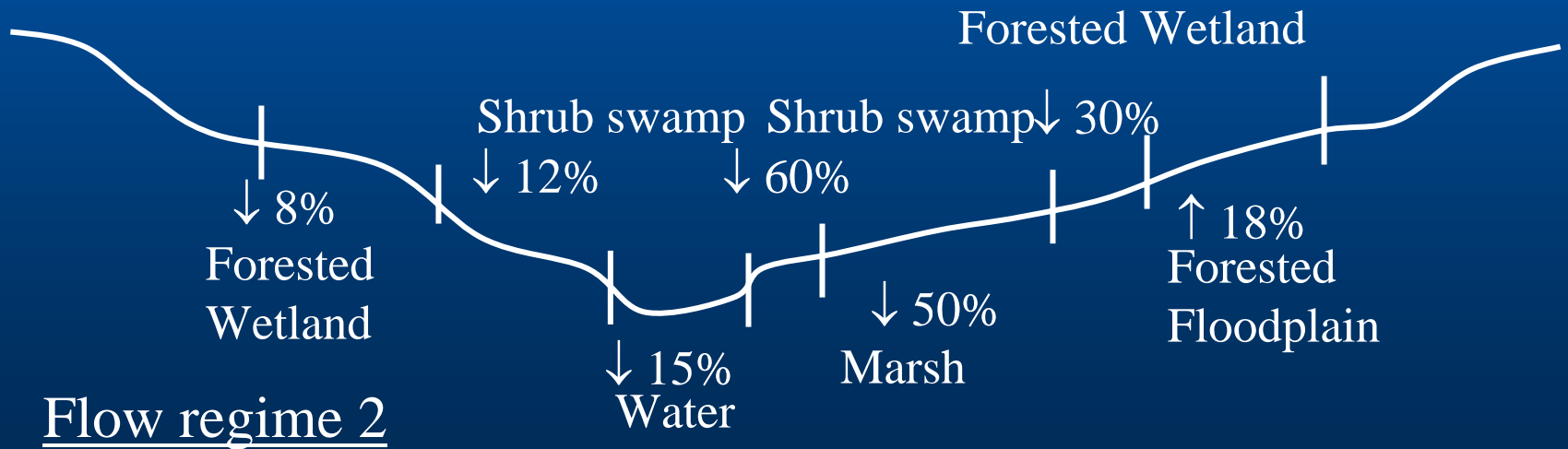
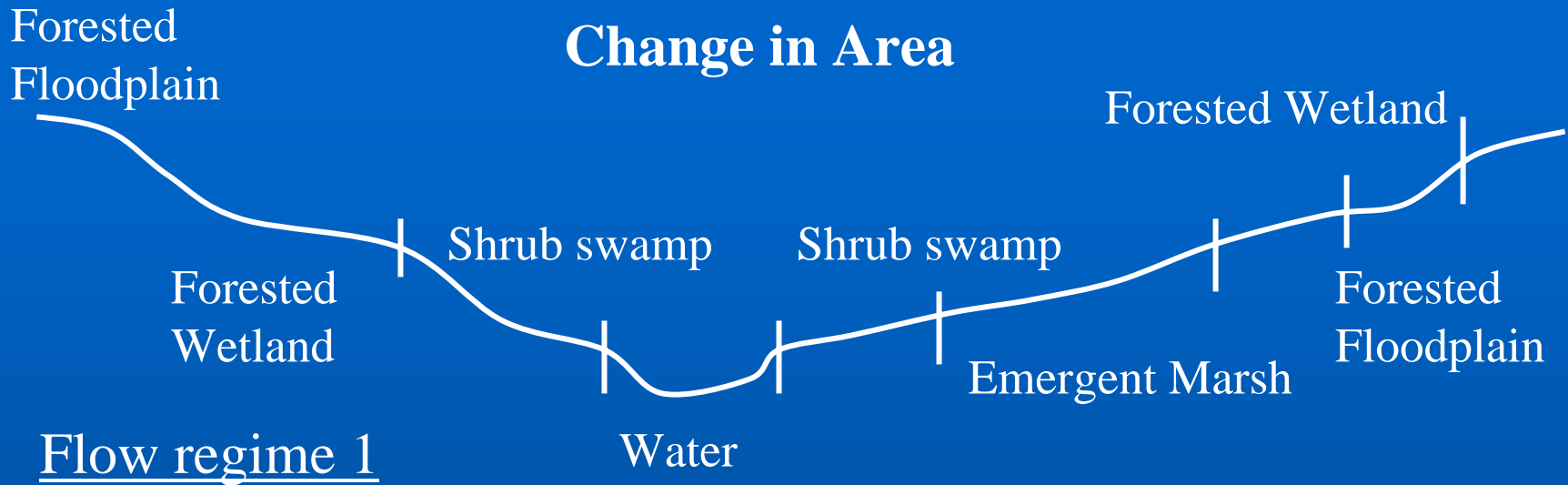
Transect #2

Adapted from Scott Jackson, UMASS

Transect #1



Adapted from Scott Jackson, UMASS



Habitat Suitability Indices Species A

Forested
Floodplain

Forested Wetland

Forested
Wetland
0.32

Shrub Swamp

0.74

Shrub Swamp

0.66

Water
0.65

Emergent marsh
0.50

Forested
Floodplain
0.40

0.46

Flow Regime 1

Forested
Floodplain

Forested wetland

Forested
Wetland
0.30

Shrub swamp

0.69

Shrub swamp

0.60

Water
0.80

Emergent Marsh
0.54

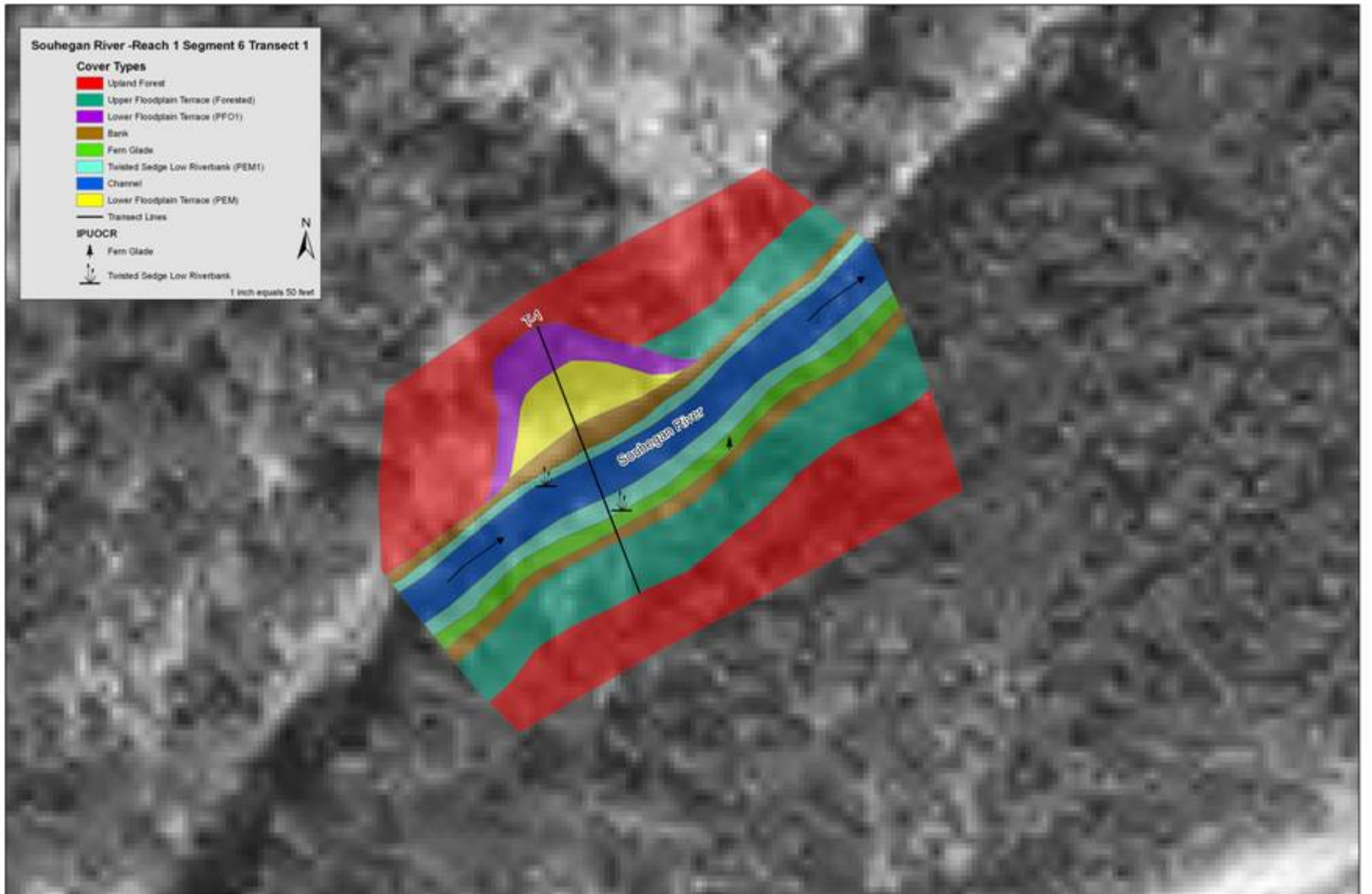
0.44

Forested
Floodplain
0.38

Flow regime 2

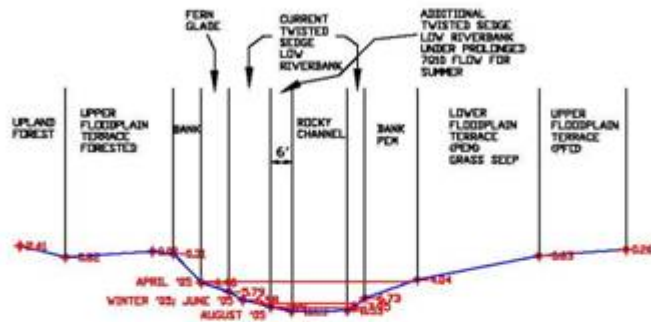
Adapted from Scott Jackson, UMASS

Reach 1 – Segment 6



Reach 1 – Segment 6

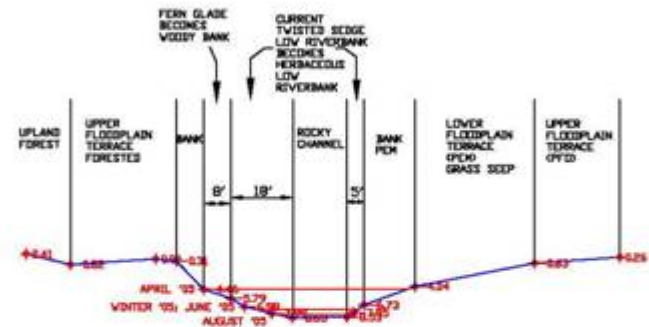
REACH 1 SEGMENT 6 TRANSECT 1 (Alt-1)



GRAPHIC SCALE



REACH 1 SEGMENT 6 TRANSECT 1 (Alt-2)



GRAPHIC SCALE



Reach 1 – Segment 6



March 2005

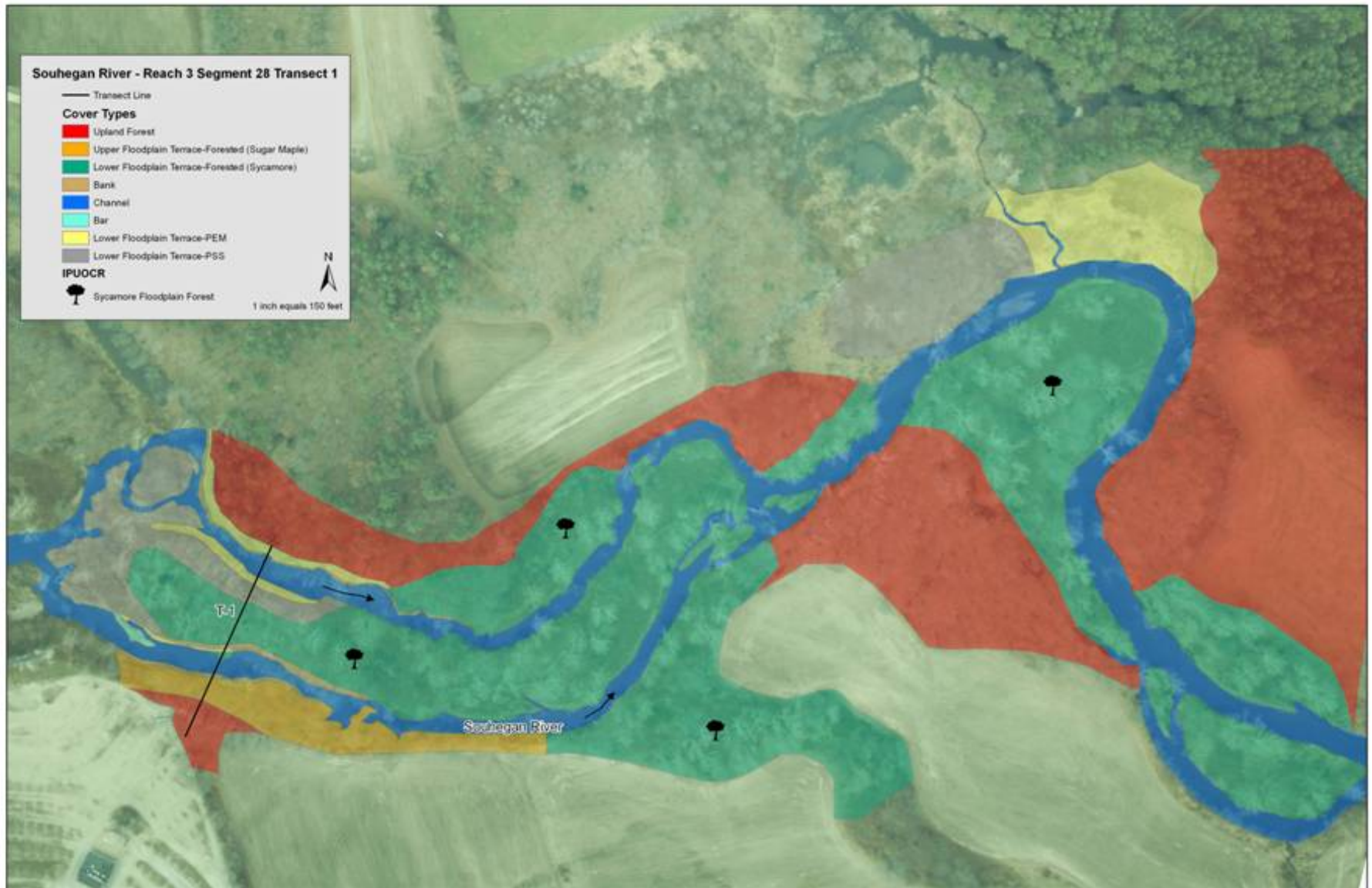


August 2005

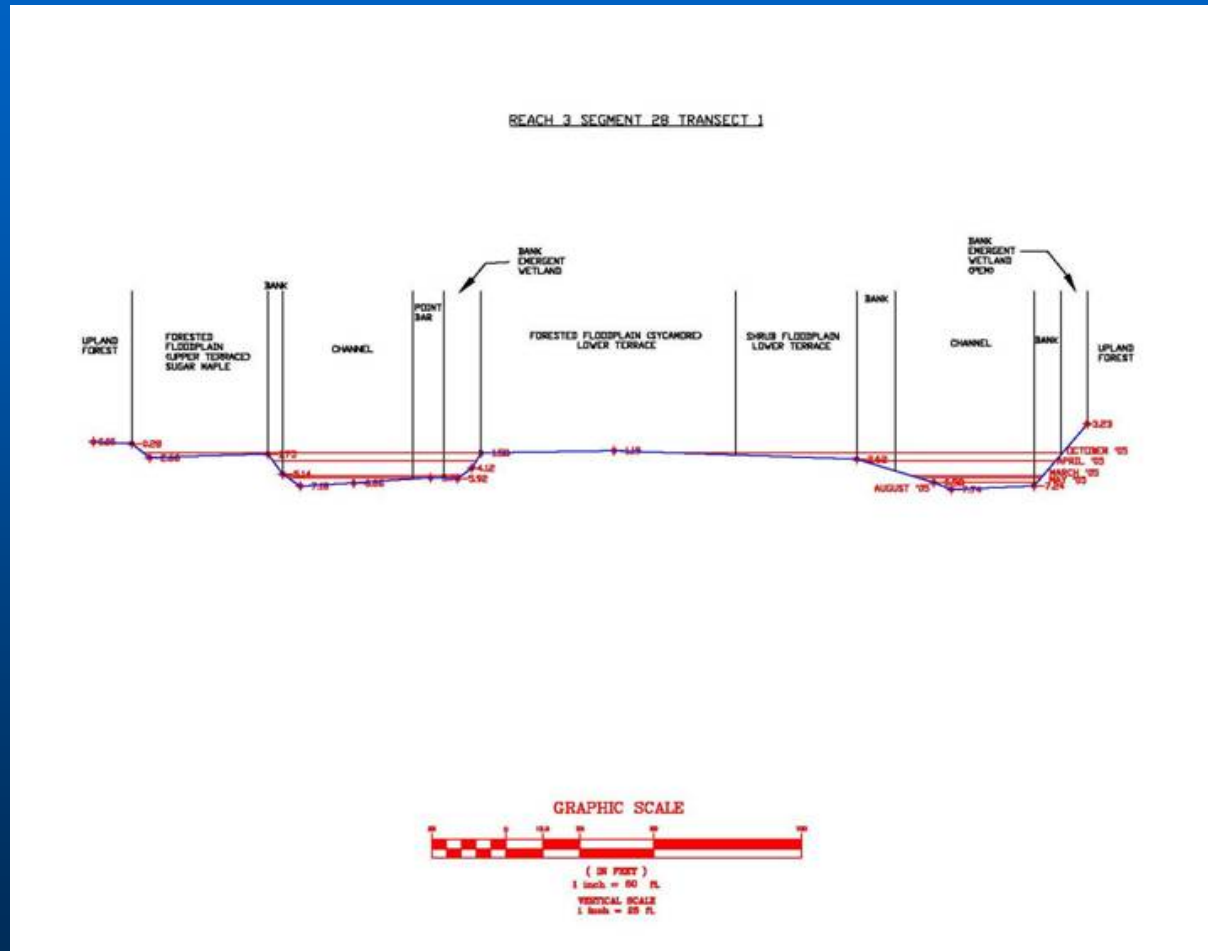


June 2005

Reach 3 – Segment 28



Reach 3 – Segment 28



Reach 3 – Segment 28



March 2005



June 2005

Reach 7 – Segments 49 & 50

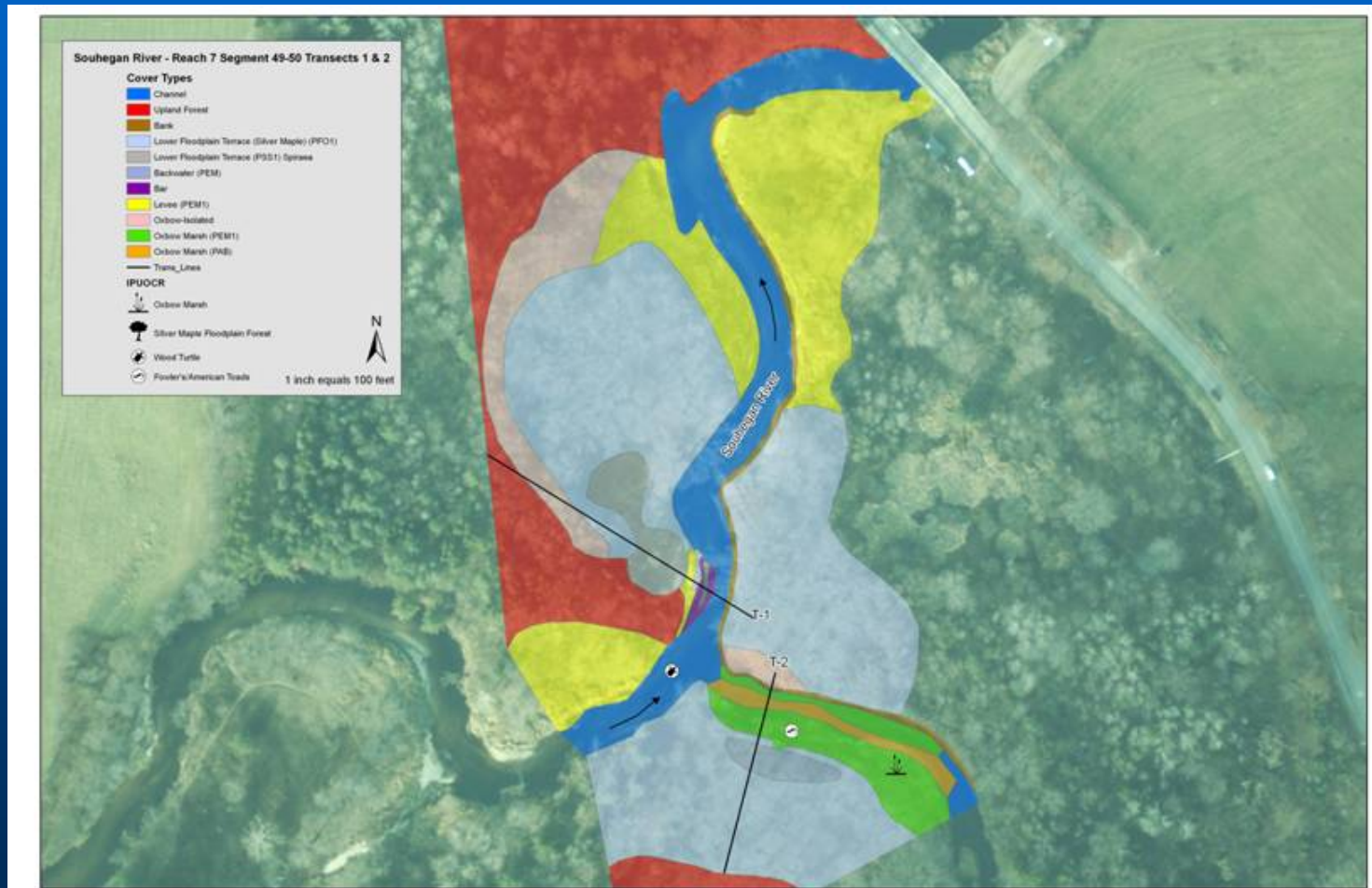


Diagram illustrating the cross-section of Reach 7 Segments 49-50 Transect 2. The diagram shows the elevation profile of the transect across various vegetation types and time periods.

Vegetation Types (from left to right):

- LOWER FLOODPLAIN TERRACE POK
- POK
- PAB
- POK
- CHANNEL DUDW MARSH
- POK BAR
- BACK WATER POK
- LOWER FLOODPLAIN TERRACE PTD
- SILVER MAPLE FLOODPLAIN FOREST
- LOWER FLOODPLAIN TERRACE FORESTED

Elevation Profiles (from left to right):

- APRIL '05: Elevation starts at 0.00 and remains relatively flat.
- MAY '05 - JUNE '05: Elevation starts at 0.00, drops to 0.12, and then rises to 0.17.
- MARCH '05 & AUGUST '05: Elevation starts at 0.00, drops to 0.12, then rises to 0.17, and finally rises to 0.25.

GRAPHIC SCALE

1 inch = 50 feet

VERTICAL SCALE
1 inch = 25 feet

Reach 7 – Segments 49 & 50



March 2005



June 2005

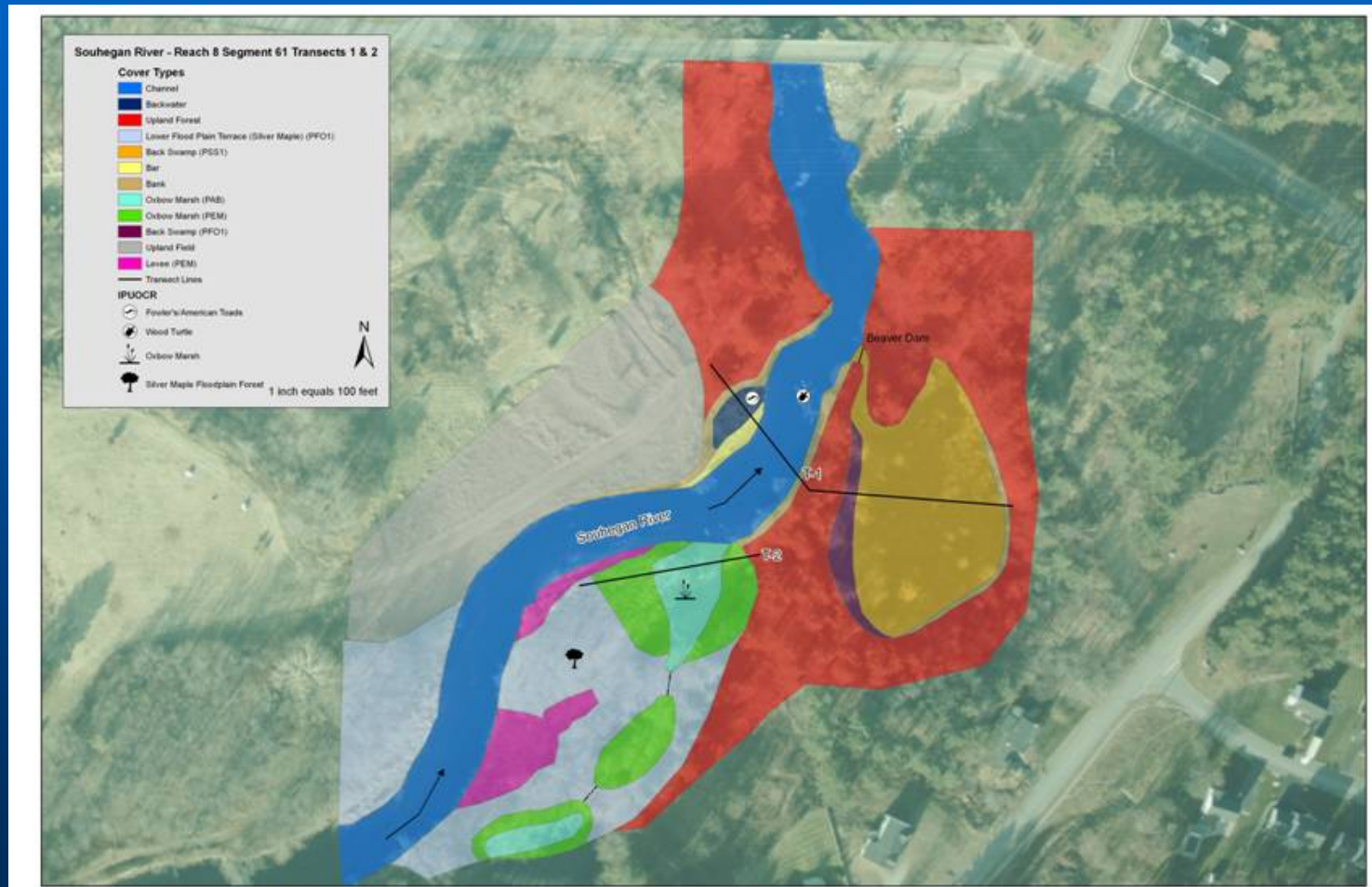


April 2005

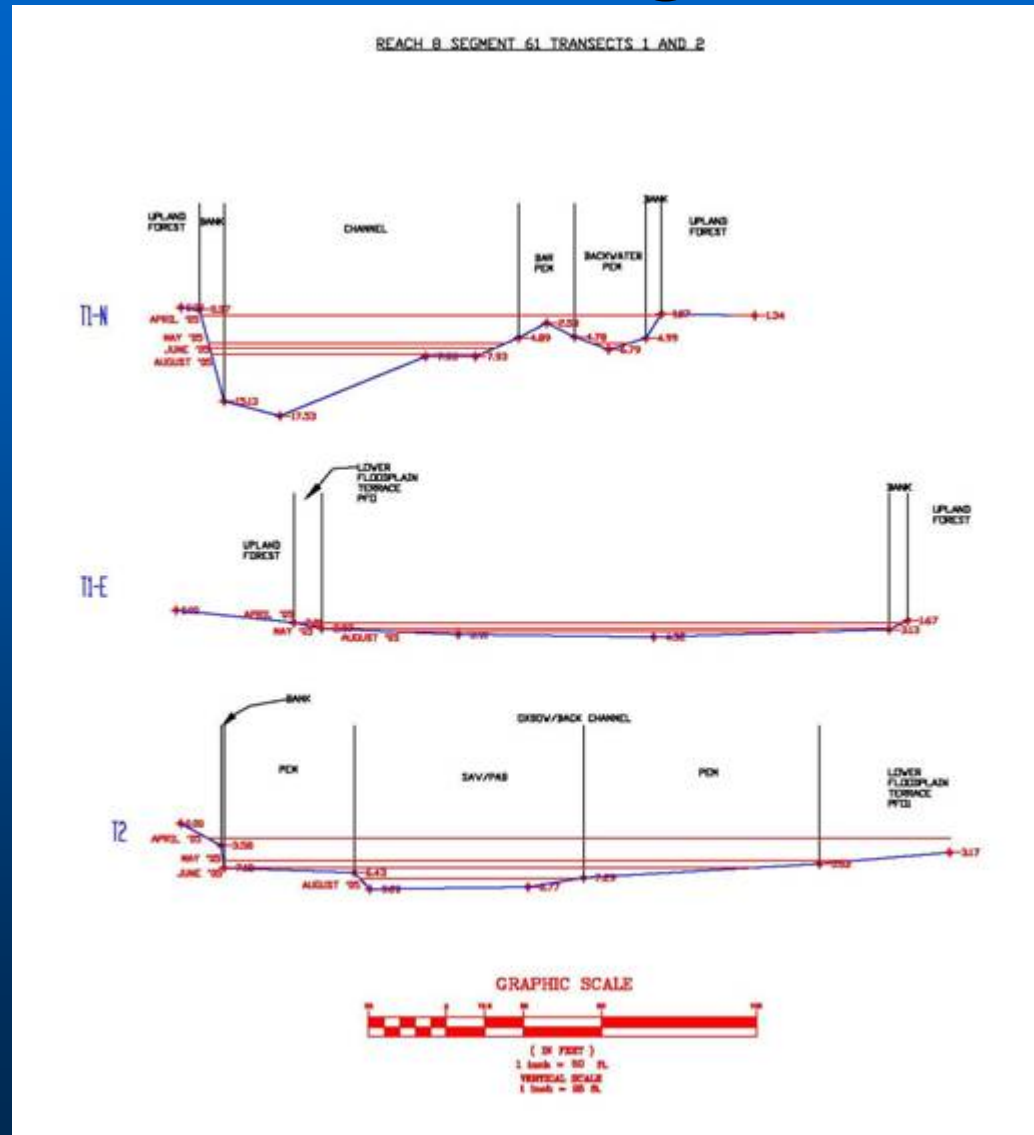


August 2005

Reach 8 – Segment 61



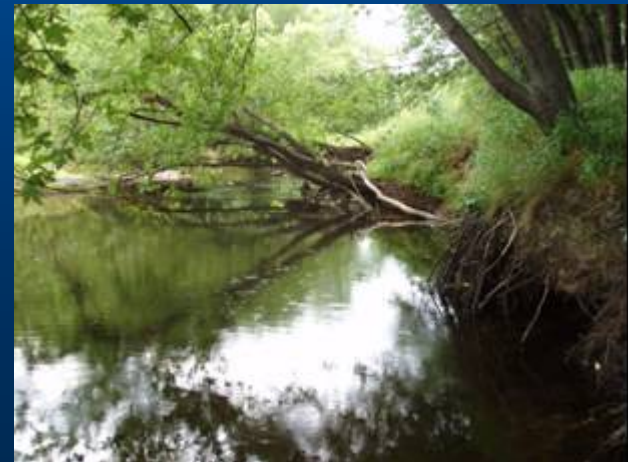
Reach 8 – Segment 61



Reach 8 – Segment 61



April 2005



August 2005

High Energy Riverbank

Twisted Sedge Low Riverbank & Fern Glade



- **Twisted sedge:** Rare to locally abundant
- Found in cobbly river margins of Reach 1 – up to 1m from summer water level
- **Fern Glade:** Status unknown
- Forms on narrow band between Twisted Sedge Low Riverbank and hemlock-northern hardwood forest terrace above
- Both communities maintained through high spring flows and winter ice scour

High Energy Riverbank

- Permanent alterations to these community types due to:
 1. Consistent reductions of summer low flows with no other seasonal changes
 2. Consistent reductions in spring flood levels, ice scour
- At a 7Q10 flow (about $\frac{1}{2}$ that of 2005 measured low flow) expect exposure of one more tier of cobbles above channel bottom
- Both community types presumably maintained by spring floods and winter scour



Reductions in extent of spring highs and winter scour could allow a shift in Twisted Sedge cover to Herbaceous Low Riverbank cover and allow woody plants into Fern Glade

Southern New England Floodplain Forest

Silver Maple (*Acer saccharinum*) Floodplain Forest



- Typical of medium to large rivers in the state
- Specific community present: Silver Maple-False Nettle-Sensitive Fern variant
- Community depends on periodic flooding and scouring for providing nutrients and reduction of competition with flood-intolerant spp.
- Less dependent on low flows

Southern New England Floodplain Forest

Sycamore (*Platanus occidentalis*) Floodplain Forest

- Community depends on periodic flooding and scouring for providing nutrients and reduction of competition with flood-intolerant species
- Low flows are less critical
- Areas of abundant Sugar Maple seedlings and saplings in this community
- Young sycamores observed in areas of frequent flood flow scouring along river edge



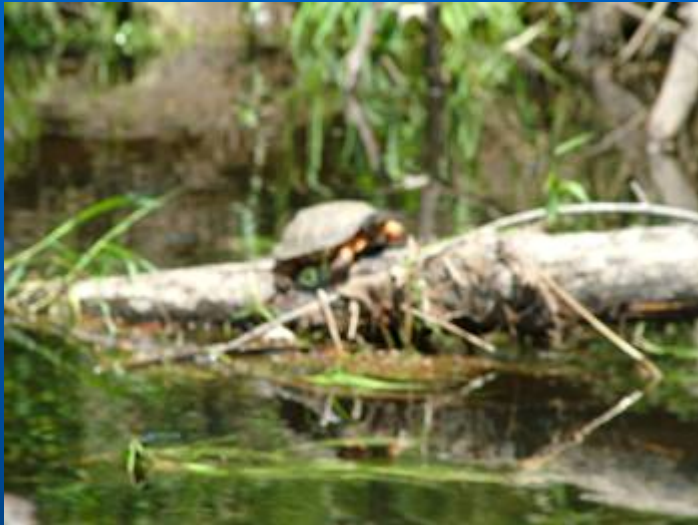
Oxbow/Backwater Marsh

- Present along low-gradient portions of the Souhegan (Reaches 4-8)
- Fill in spring as lower floodplain floods and drain slowly through summer
- Highly adaptable to temporary fluctuations in water levels during any season
- These flow dependent communities do require the following:
 1. High spring flows to fill marshes
 2. Slowly declining water levels May-Aug
 3. Sufficient water May-Sept to keep rhizomes wet



Wildlife

Wood Turtle



- Utilizes low gradient, slow moving rivers/streams with sand/gravel substrates and dense shrub/vine borders
- Move frequently between land and water – hampered by steep banks
- Steep 5-9 ft. banks of low-gradient sections of the Souhegan make for relatively poor habitat
- Individual observed in Reach 7 with potential habitat in Reaches 4, 5, 6, and 8

Adverse Water level changes

1. Drop in winter levels below late fall levels – exposing turtles
2. Release of water in June-Sept. flooding nests in the floodplain
3. Flow changes that increase water velocity or accelerate channel incision

Wildlife

Fowler's Toad

- Historical records from Amherst in Reaches 6&7
- Prefer sandy, outwashed soils
- Reduction in flows that expose shallow river margins, backwaters and oxbows during larval periods can strand and eliminate tadpoles



- Critical water levels include standing water at least 3 inches deep in backwaters and oxbows until mid-August

Wildlife

Pied-billed Grebe



- Preliminary inspection reveals no marshes of required size within 500 feet of Souhegan

Osprey



- Flows protective of a healthy fish community will benefit this species

Common Loon



- Flows protective of a healthy fish community will benefit this species

Plant Species

Long's bitter cress

- Obligate aquatic plant
- Record of this species from Souhegan is likely a reporting error

Wild Garlic

- Faculative upland plant
- Information suggests that it occurs on upper terraces of streams and rivers and is typically affected by infrequent flooding events – may be somewhat dependent on periodic scouring for survival

Wild Senna

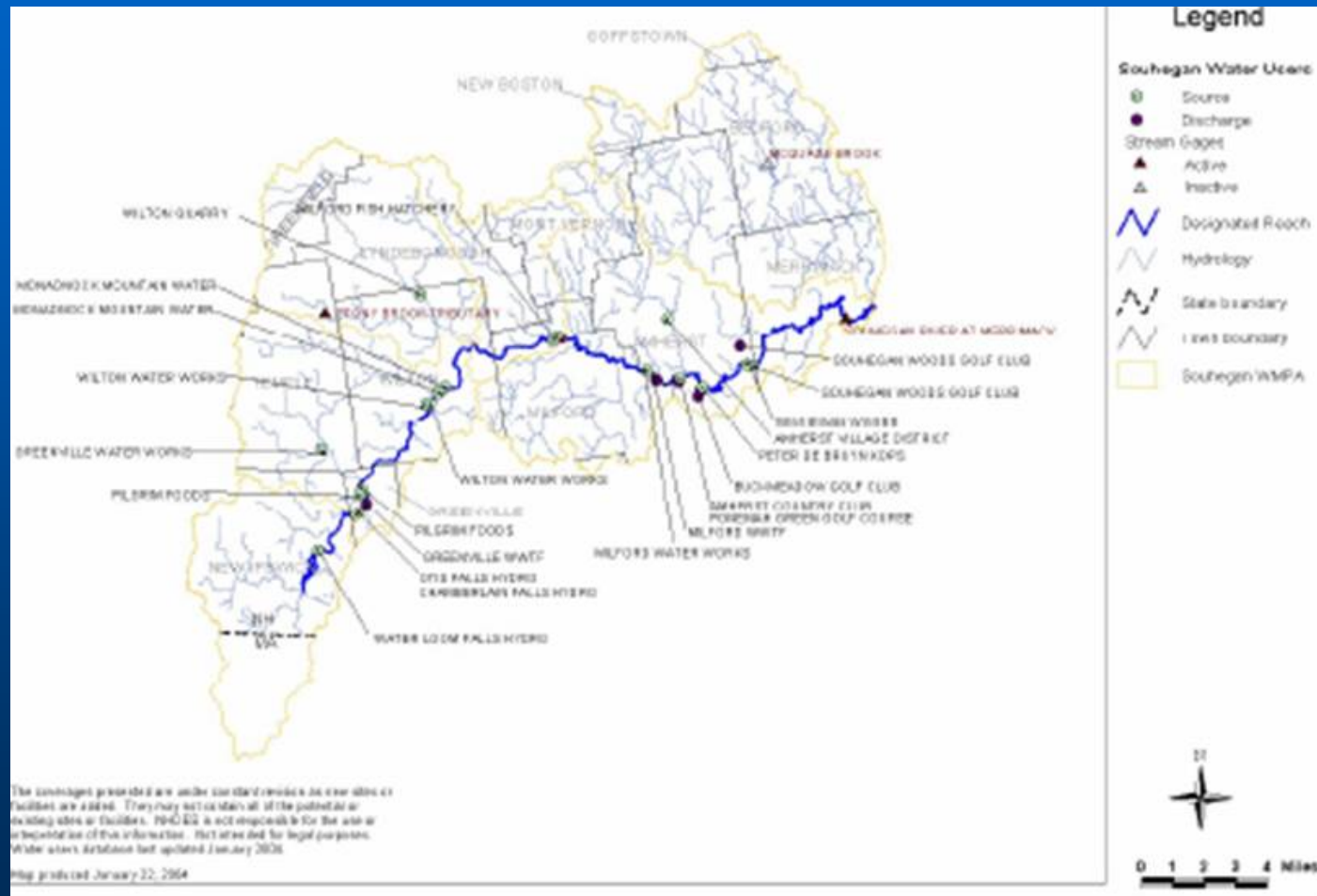
- Faculative upland plant
- Confirmed during field studies
- May be partially dependent on floods to maintain canopy openings but is not dependent on low or average flows



PISF to WMP

- Different resources dependent on different flows (low, average, high)
- Where possible, flows will be described in terms of frequency of occurrence and duration of events relative to benchmarks
- Multi-species approach will be used where appropriate
- Alternatives for water use, conservation and dam management identified
- Conflicts among resource needs and between resource needs and water user/dam owner needs will be identified, if present
- MCDA is one tool we will look at for resolving conflicts

ring produced January 22, 2004



Types of Water Users and Dam Owners

- Golf Courses – spring/summer water use
- Water Supply – year round use
- Hydropower – fall through spring
- Industrial/Food Processing – year round
- Agricultural – summer water use
- Fish Hatchery – year round use

Water Use

Average August Withdrawal (cfs)

Upstream of:

Wilton	Surface 1		0.23
	Surface 2		0.21
Merrimack River	Surface 3		0.26
	New User	estimated	0.3
	Surface 4		0.03
	Surface 5		0.4
	GW 1		1.5
	GW 2		<u>0.3</u>
Total			3.23

Available Flow for Management

- Average August flow from all water withdrawals is 3.2 cfs.
- At times (specific days or time of day) flow attributable to withdrawals is higher.
- Most larger withdrawals are in lower section of river
- Some withdrawals return flow to river
- Some groundwater withdrawals return as surface discharges
- Potential for managing these uses to affect stream flow depends on location

Distribution of Affected Dams



Issues related to Dam Management

- Mainstem dams have virtually no storage
- Lakes and ponds in watershed have limited storage capacity and limited summer drawdown potential
- Flood control impoundments present the greatest opportunity for storage

Potential Storage in Impoundments

		Potential Release (cfs)	
Upstream of:		30 days	7 days
Wilton	Flood control	176	757
	Other	27	116
Merrimack R.	Flood Control	176	757
	Other	40	167

Typical Flood Storage Impoundment



Issues with Use of Flood Control Impoundments for Flow Augmentation

- Loss of Flood Storage
- Potential Water Quality Issues
 - Oxygen
 - Nutrients
- Temperature of Releases
- Habitat Changes in Impoundments
- Capital and Operating Costs
- Engineering/Geotechnical Considerations